



NATIONAL RADIO ASTRONOMY OBSERVATORY

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Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of)
)
Amendment of the Commission's Rules to) WT Docket No. 04-435
Facilitate the Use of Cellular Telephones and)
other Wireless Devices Aboard Airborne)
Aircraft)

Comments of the
National Radio Astronomy Observatory
Charlottesville, VA 22903

I. Introduction, Background and Summary of Concerns

1. The National Radio Astronomy Observatory (NRAO) is pleased to provide comments responding to the Commission's Notice of Proposed Rule Making FCC 04-288 "Amendment of the Commission's Rules to Facilitate the Use of Cellular Telephones and other Wireless Devices Aboard Airborne Aircraft (WT Docket No. 04-435)" ("The NPRM").
2. NRAO (<http://www.nrao.edu>), operated by Associated Universities, Inc., (<http://www.aui.edu>) under a cooperative agreement with the National Science Foundation, is the largest radio astronomy observatory and one of the largest astronomical observatories of any kind in the world. It employs some 600 people in several of the United States as well as the US Virgin Islands and Chile, and is responsible for much of the basic research conducted by the radio astronomy service world-wide. NRAO currently operates the Very Large Array (VLA) in Socorro, New Mexico, the Robert C. Byrd Green Bank Telescope in Green Bank, West Virginia and the Very Long Baseline Array (VLBA), an array of ten antennas spread across the United States and from Hawaii to St. Croix.
3. As a public institution, the NRAO is charged on behalf of the American people with conducting and encouraging the practice of radio astronomy: the Observatory believes it has been successful in this enterprise, as its facilities were used by more than 1100 scientists and students from nearly 250 institutions during 2003 (the last full year for which complete statistics are available). As the operator of a capital plant comprised of public property valued in excess of \$275,000,000 at a variety of remote stations, all of whose operations stand to be affected by the proposed rulemaking, the NRAO is obliged

to express concerns for the continued success of its operations. The Observatory asks that any new service rules permitting airborne use of cellular telephones take account of the possible effects of such use upon its operations.

II. Possible effect of airborne use of the 800 MHz band upon the NRAO's remote stations of the radio astronomy service

4. All of the Observatory's stations observe cosmic radiation of the OH molecule and continuous radiation from various cosmic phenomena in the band 1660.5 – 1668.4 MHz (hereafter described as "the OH band"). The OH band is protected by inclusion in **US246** ("No station shall be authorized to transmit in the following bands: ..."). Conversely, **US74** also applies, reading in part "In the bands ... 1660.5 – 1670 MHz ... the radio astronomy service shall be protected from extraband radiation only to the extent that such radiation exceeds the level which would be present if the offending station were operating in compliance with the technical standards or criteria applicable to the service in which it operates."
5. Cellular telephones operating in Channel Block A (869-880 MHz paired with 824-835 MHz) are likely to emit harmonic extraband radiation in the band 1660.5 – 1668.4 MHz. At present, such radiation is of little consequence to the Observatory's stations, as they are protected by remoteness, terrain-shielding *and the adherence of all concerned to strict rules forbidding cellular phone use on Observatory grounds (i.e. near the radio telescopes)*.
6. Such protections will not be afforded when cellular telephones are used aboard aircraft. Indeed, scenarios for sharing between RAS and AMSS such as are cited in the Commission's NPRM FCC 05-14 ("Service Rules and Procedures to Govern the Use of Aeronautical Mobile Satellite Earth Stations ...", IB Docket No. 05-20; hereafter "the NSF-AMSS MOU") at footnote 87 use as a basis for calculation the fact that 300 aircraft (of all types) may be visible at one time at an observatory. Thus, many thousands of active cellular telephones might also be visible.
7. Rec. ITU-R. RA.769 states that the threshold level of detrimental interference for radio astronomy at 1665 MHz is $-237 \text{ dBW/m}^2/\text{Hz}$ in any 20 kHz segment of the band (henceforth, described as "RA. 769 levels"). For a single aircraft directly overflying at an elevation of 9.1 km (30,000 ft; cited in the NSF-AMSS MOU) this translates to a spectral eirp of $-73.8 \text{ dBm}/20 \text{ kHz}$; that is, an eirp of -73.8 dBm into any 20 kHz interval. Alternatively, if spread uniformly over a broader interval, an eirp of -56.8 dBm in 1 MHz. These figures are per aircraft (the aggregate of all contained handsets) for radiation leaving the craft and represent the highest levels which would protect radio astronomy given the assumed conditions.
8. To estimate the effect of a distribution of aircraft, we performed a calculation based on the parameters of the NSF-AMSS MOU, whereby a total of 300 aircraft were distributed uniformly over a flat sheet of radius 341 km passing 9.1 km above the observatory; 341 km is the purely geometric line of sight slant distance to the sea-level horizon from an elevation 9.1 km above sea level. The calculation neglects both the curvature of the

earth and the elevation of the observatory, but these are unimportant. Such a simulation produces only about 2 dB more radiation at the observatory than the single-craft overflight scenario discussed in the previous paragraph: carving out an exclusion zone of radius 40 km in the sheet (centered above the observatory) only diminishes the received radiation by 2 dB. The upshot of this calculation is that the single-craft scenario is a reasonable benchmark (if the number and density of aircraft have been reasonably estimated) and exclusion zones will have little effect if the dominant source of potential interference is an extended distribution of aircraft.

9. In the NPRM at ¶4, the Commission notes that cellular phones using the CDMA air interface may be commanded to function at levels as low as -50 dBm. Given the attenuation likely introduced by the body of a large commercial aircraft and the fact that potential interference arises only in the first harmonic, such levels of operation would probably protect radio astronomy at RA. 769 levels, even if several dozens of handsets were operating aboard each such craft.
10. Not all air interfaces function at such low levels and the Commission's rules for extra-band radiation typically specify only that no more than -13 dBm appear in a 1 MHz measurement band (e.g. 47 CFR § 22.359). Thus, it is possible that current handsets operating on the ground in compliance with the relevant technical standards and criteria -- and so protected under US74 -- are actually prevented from producing emission in excess of RA. 769 levels at the Observatory's stations *only* by the other protections noted at ¶5 here.
11. NRAO concludes that, whereas the Commission's present technical standards and criteria result in handsets whose unwanted emissions are tolerated by the RAS during terrestrial use, emission from the same compliant handsets could exceed RA. 769 levels during airborne use. In the absence of new requirements on extraband radiation during the proposed rule-making, the Observatory would have no choice but to accept such emissions, under **US74**, even while hundreds of aircraft and thousands of operational handsets were within line of sight.
12. Therefore, the Observatory requests that the Commission require that cellular telephones and other devices operating in the relevant band while airborne comply with explicit restrictions on the amount of radiation which they are allowed to produce at 1660.5 – 1668.4 MHz. Such restrictions could be formulated based on sharing scenarios like those developed in the NSF-AMSS MOU, tailored to the particular case at hand of multiple handsets operating within the body of the aircraft, under whatever technical restrictions the Commission develops for the on-board picocells, *etc.* Examples of eirp levels per aircraft which would protect the radio astronomy service in one sharing scenario are given at ¶7-8 here. Another possibility is that the frequency range 830.25 – 834.2 MHz be excluded from airborne use.
13. Such requirements as requested in the previous paragraph should be extended to the secondary services discussed by the Commission in the NPRM at ¶24. At ¶25 in the NPRM the Commission seeks guidance on whether it should limit the amount of cellular spectrum that may be used for secondary air-to-ground operations. The Observatory

suggests that cellular spectrum having the possibility of harmonic radiation into the OH band (*i.e.* at 830.25 – 834.2 MHz) should be excluded from such use.

14. The Commission proposes to revise § 22.925(b) to read, in part,

(b) Devices using 800 MHz cellular frequencies may be operated on airborne aircraft only if such devices are operated in a manner that will not cause interference to terrestrial cellular systems.

The Observatory believes that this wording is too limited and may give the impression that interference to other systems (like those of the radio astronomy service) has been discounted by the new rulemaking. If the Commission accepts suggestions such as those at ¶12 -13 here, such would not have been the case.

III. Summary of concerns and recommendations

15. At present the Observatory's operations in the protected band 1660.5 – 1668.4 MHz are adequately isolated from unwanted radiation from cellular telephones operating in the 800 MHz band by some combination of geographic isolation, terrain-shielding, interdiction of use on Observatory grounds, and the innate levels of extraband harmonic radiation emitted by such devices under current service rules. However, the protective conditions of geographic isolation, terrain-shielding and interdiction will not occur during airborne mobile use and the presently-permitted levels of extraband radiation are by themselves not demonstrably sufficient to protect the Observatory's operations in the presence of potentially thousands of handsets operating within direct line of sight.
16. Therefore, the Observatory requests that new service rules allowing airborne mobile use of cellular telephones operating in the 800 MHz band should restrict the amount of extraband cellular telephone radiation which may fall into the protected 1660.5 – 1668.4 MHz band. Such restrictions could be based on sharing scenarios and eirp limits such as are discussed here at ¶7 and beyond, or operations in a part of the 800 MHz band (830.25 – 834.2 MHz) might simply be prohibited.

Respectfully submitted,

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